Eurasian Journal of Educational Research 82 (2019) 191-202

Eurasian Journal of Educational Research
www.ejer.com.tr

The Contribution of Test Type and Curriculum Difference on the Effect of the National Test Score at International Mathematic Test Score: The Challenge of IR 4.0 Curriculum

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ARTICLE INFO

Article History:

Received: 13 Feb. 2019

Received in revised form: 8 Apr. 2019

Accepted: 28 Jun. 2019

DOI: 10.14689/ejer.2019.82.10

Keywords

Learning evaluation, educational policy, learning result

ABSTRACT

Purpose: The students' competencies of math are required to be assessed by using an international scale of evaluation. Thus, education policies and learning evaluation are developed by educational policymakers to improve the education system and result quality. Hence, the purpose of this research was to investigate The Contribution of International Mathematics Test Type and Curriculum Difference on the Effect of the National Test Score on International Mathematics Test Score.

Research Methods: This study employed 600 students of private and public Junior High Schools in Indonesia. The Mathematics Test Types included were PISA-like and TIMSS-like. They were used to represent the type of test. The model of curriculums applied in Junior High School in Indonesia used in this study was KTSP and K13. The multiple regression was used to analyze the data.

Findings: The National Test Score had a stronger effect on International Mathematics Test Score for KTSP curriculum implementation rather than K13 curriculum, and National Test Score had a stronger effect on International Mathematics Test Score for PISA type of International mathematic test rather than TIMSS one. These results showed that the different curriculum used at the mathematics learning process and test types had a moderate effect of National on International test score in a mathematics course.

Implications for Research and Practice: It implies an increase in the policymakers to pay more attention to the curriculum design and type of learning evaluation. It is suggested that future research should include learning and teaching types to find out a deeper behavioral and attitudinal understanding of learning and teaching of mathematics.

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Introduction

The issues of Industrial Revolution 4.0 (IR 4.0) are believed to affect the curriculum design to adjust student learning (Coşkun, Kayıkcı, & Gençay, 2019; Fung, 2019; Lan & Vu, 2018; Lieu, Duc, Gleason, Hai, & Tam, 2018). The IR 4.0 requires the standards of learning processes and output in global competition. Hence students' mathematics skill is recently required to be assessed by using international scale of evaluation (Chow & Ekholm, 2018; Moyer-packenham et al., 2018). Programme for International Student Assessment (PISA) and Trends in International Mathematics and Science Study (TIMSS) are usually used to measure international mathematical skills. PISA is used to measure the reading literacy, math literacy, and science literacy. The term of literacy in PISA is related to the readiness of students on the future workplace, i.e. the ability to apply knowledge and skills to a subject that includes analysis skills, give a reason and make an effective communication for various problems in different situations (OECD, 2013). TIMSS is used to measure Mathematics and Science achievement (Mullis, Martin, Ruddock, Sullivan, & Preuschoff, 2009). Hence, the results of PISA and TIMSS can compare the capability of different students on mathematics among countries. Those international tests show the rank of the country on the result of their students' scores on PISA and TIMSS.

The PISA scores of Indonesian students showed that the literacy score is under the average of OECD. Their TIMSS score indicated that their mathematics skill has got lower and lower from 1999 to 2011. In the period of 1999/ 2000, the rank of Indonesian students among all the participating countries was 39 in 41 (95.12) for PISA and 34 in 38 (89.47) for TIMSS, whereas in 2003 period, Indonesian students reached the rank of 38 in 40 (95.00) for PISA and 35 in 46 (76.09) for TIMSS. In the period of 2006/ 2007, the rank of Indonesian students among the countries was 50 in 57 (87.72) for PISA and 36 in 49 (73.47) for TIMSS, then reached the rank of 61 in 65 (93.85) for PISA and achieved 64th place in 65 (98.46) for PISA and 38 in 42 (90.48) in 2011/ 2012. Finally, in the period of 2015 PISA achievement for Indonesian student reached at the rank of 66 in 72 (91.67) (Mullis, Martin, Foy, & Arora, 2011; OECD, 2013, 2015). Hence these PISA and TIMSS achievements encouraged the education policy makers to develop the mathematical learning system to reach higher achievements. Scholars were also promoted to investigate various antecedents related to the international test results.

The Rationale for the Study and Design

Since various approaches to mathematics tests are designed by education policymakers, the curriculum is believed to increase the international test scores. The curriculum is designed to increase students' achievement in mastering various abilities on a subject (Dekant, Sungur, & Yerdelen, 2018; Mullis et al., 2009). The results of PISA and TIMSS are used to evaluate and re-formulate the education policies by various countries (Carnoy, Khavenson, Loyalka, Schmidt, & Zakharov, 2016; Jansen, Schroeders, Lüdtke, & Marsh, 2019). Accordingly, it is plausible that this study aimed to investigate the effect of the result of national tests on international ones, where the curriculum and type of mathematics tests are used to moderate the model. Hence, the

contribution of test type and curriculum on the model is clearer. The novelty of this study is to examine and verify the contribution of different type of PISA and TIMMS, and different curriculum of KTSP (stand for *Kurikulum Tingkat Satuan Pendidikan* or Education Unit Level Curriculum) and K13 (stand for *Kurikulum* 2013 or Curriculum 2013).

Scholars believed that theoretically national test scores are related to the international scale of mathematics achievement (Carnoy et al., 2016; Stacey, 2011). Hence the mathematic test in the level of national policy is designed to predict the international scale one. It is found that when students achieve a higher score of the school or nation test, they also get a better TIMSS score (Kaleli-Yılmaz & Hanci, 2015). Accordingly, governments try to include the PISA and TIMSS test type in their national test to increase international mathematics' test score. The total items of PISA and TIMSS type tests were increased in national tests to adapt students, and similarity of those tests on the international test types were also increased (Kaleli-Yılmaz & Hanci, 2015; Retnawati, 2017). Replication of Yilmaz & Hanci is needed to demonstrate the relationship between national and international test scores (Kaleli-Yılmaz & Hanci, 2015). However, few researchers investigated the effect of national test score on the international test score. PISA and TIMSS tests have a different objective to measure (Wu, 2010). The content of PISA and/or TIMSS within the national test is believed to have various effects both in national and the international test scores. Empirically, different achievements of Indonesian students on international mathematics score could be predicted by various antecedents. Many researchers found that characteristics and quality of school and students contribute to student achievement. They argue that learning opportunity and teacher quality have different effects on mathematics score of students. The number of students in a class and socioeconomic status of the school is indicated to be a strong predictor of PISA score (Argina, Mitra, Ijabah, & Setiawan, 2017; Carnoy et al., 2016; Lam & Lau, 2014; Mcconney & Perry, 2010). Hence the study of the effect of national test scores on international test scores in different types of tests is needed.

The curriculum is believed to influence the mathematics skills of students. Scheerens found that educational effectivities are related to student achievement (Scheerens, 2019). The intended, implemented, and achieved curriculum are used to plan, control, and evaluate student achievement (Martin & Mullis, 2016). The KTSP and 2013 curriculum is used in different ways to apply education in Indonesia. The difference of both curriculum types is related to knowledge and skill intention, and learning and evaluation system (Retnawati, Hadi, & Nugraha, 2016). The 2013 Curriculum is close to a student-centered rather than a teacher-centered approach. It uses authentic tests to assess student attitudes, knowledge and skill whereas KTSP tends to use knowledge and skill test. Those different types of curriculum are argued to have various results in student achievements as well as PISA and TIMSS score. The 2013 curriculum type is used as an alternative of KTSP type to increase international mathematics skill. However, both curricula used national tests to measure the mathematics score of student achievement in the scale on the national area. Hence, it is plausible if the 2013 curriculum achieves a better score of international tests rather

than KTSP. However, the studies of evaluation of international mathematics score on both curricula are not conducted. Thus, there is a need for a study investigating the influence of different curriculums on the effect of national test scores on international mathematics score.

This study aimed to investigate the different types of test and curriculum on the effect of national test scores on international mathematics score. It is hypothesized that the score gained from a national test of mathematics has an effect on the score of international tests and different types of the curriculum (K13 and KTSP), and international test types (PISA and TIMSS) have different effects on the national-international test scores. Concordantly, this study is significant in three aspects. Firstly, it strengthens the evidence of the importance of the effect of national mathematics test score on the international score. Secondly, it may explain the significant contribution of International Mathematic Test Type on the effect of National Test Score on International Mathematics Test Score. Finally, it can make significant contributions to curriculum difference on the effect of national test score on an international mathematics test score.

Method

Research Design

The moderation model was used to investigate the different types of tests and curriculum to predict the international mathematics test score based on the national test scores. Multiple regression was used to analyze the model. The moderation effect of curriculum and test types were analyzed by using the multiple regression (Hayes, 2013).

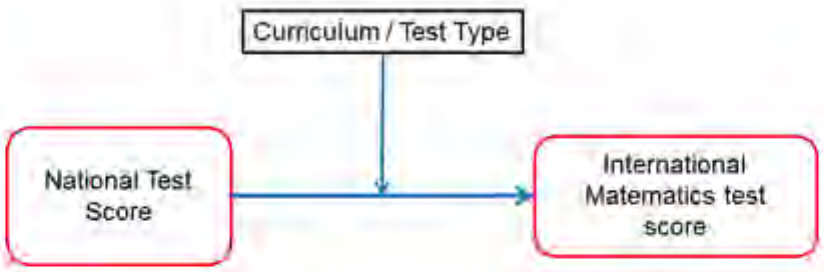

Figure 1: *Research Model*

Sample

This study employed 600 students with different achievement levels of national test scores on a random base. The post-facto data of the result of the national test score in 2016 were used in both KTSP and 2013 curriculum.

Table 1.

Participants

	Category	Participant
National test score	Low	200
	Average	200
	High	200
International test	PISA	300
	TIMSS	300
curriculum	KTSP	304
	2013 curriculum	296
School	Public	263
	Private	337
Gender	Male	279
	female	321

Research Instruments

This study used PISA model of mathematics test (16 items, Cronbach α= 0.835) based on process, content, and context domain (OECD, 2013). The TIMSS model of mathematics test was used (16 items, Cronbach α= 0.837) based on the cognitive and content domain (Mullis et al., 2009).

Data Analysis

The data were gathered from the scores of students' tests of mathematics course in public and private schools. The schools that apply K13 and KTSP curricula were chosen in this study. The Test of Kl-Smirnov showed that the unstandardized residual of the model was .104, the result of ANOVA showed significance value was higher than .05, and tolerance result was higher than 0.1. Hence, the data showed normality, linearity, multicollinearity, and heteroskedasticity of the model. The average score of national mathematics test was 28.71 with a minimum score of 3.23 and a maximum score of 96.77. The average TIMSS score was 8.6 with a minimum score of 1 and the maximum of 30, and the average PISA score was 5.9 with a minimum of 1 and maximum of 18. The descriptive analysis revealed that the average national mathematics score was higher for public schools rather than the private ones (32.37 vs. 25.86), whereas TIMSS score was higher in public schools rather than private ones (9.78 vs. 7.75), and PISA scores for public schools were higher than private ones (6.63 vs. 5.36).

Results

Multiple regression analysis was used to analyze the hypotheses. The result of this study showed that initially, the National Test Score had a significant effect on the International Mathematics Test Score (β=.545***; ΔR^2=10%). A higher score of national tests indicated a better international score of mathematics skills. Whereas the different type of tests had no significant effects on International Mathematics Test Score (β=.043; ΔR^2=18%). The interaction of national test score and test type had a significant effect on the International Mathematics Test Score (β=-.252; ΔR^2=50%). The high contribution of the model (ΔR^2=50%) showed that the type of test has a sufficient ability to explain the different findings of the effect of National Test Scores on International Mathematics Test Score. Surprisingly, Figure 2 explains that PISA type of tests contributes to having a better effect of national test score of mathematics on the international one rather than TIMSS. Hence, the hypotheses were proven.

Table 2.

Contribution of IMTT on the Effect of NTS on IMTS

	step 1	step 2	step 3	step 4
School Status	,173***	,271** *	,270** *	,274** *
National test (UNmc)		,545** *	,545** *	,785** *
Test type (IMT)			0,043	0,043
UNmc*IMT				-0,252*
R^2	0,23	0,33	0,41	0,73
ΔR^2	0,23	0,1	0,18	0,5

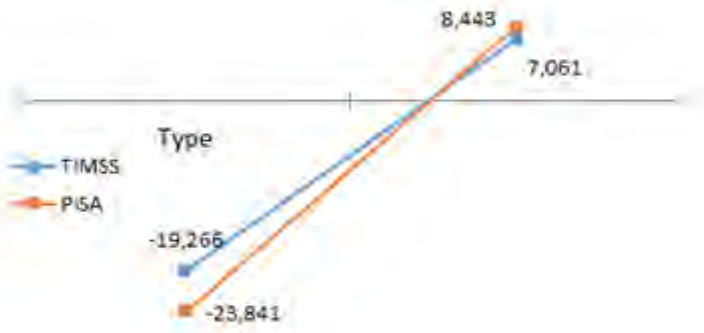

Figure 2. *Contribution of IMTT on the Effect of NTS on IMTS*

Table 3 and Figure 3 shows that interestingly, the National Test Score had a consistent effect on International Mathematics Test Score on different curriculum (β=,486, ΔR^2=10%). A higher score of national tests indicated a better international score of mathematics skills. The different curricula had a significant effect on International Mathematics Test Score (β=,353, ΔR^2=2%). The interaction of national test score and test type had a significant effect on the International Mathematics Test Score (β=,195, ΔR^2=12%). The contribution of the model (ΔR^2=12%) revealed sufficient data to explain the different findings of the effect of the National Test Score on International Mathematics Test Score. Figure 2 explains that KTSP type of curriculum contributed to the better effect of national test score of mathematics on the international one rather than 2013 one.

Table 3.

Contribution of Curriculum on the Effect of NTS on IMTS

	step 1	step 2	step 3	step 4
School Status	,173***	0,101**	0,234***	0,257***
Curriculum Type (CT)		,353***	0,131**	0,125**
National Test (UNmc)			,486***	0,346***
UNmc *CT				0,195***
R^2	0,31	0,33	0,41	0,43
ΔR^2	0,31	0,02	0,1	0,12

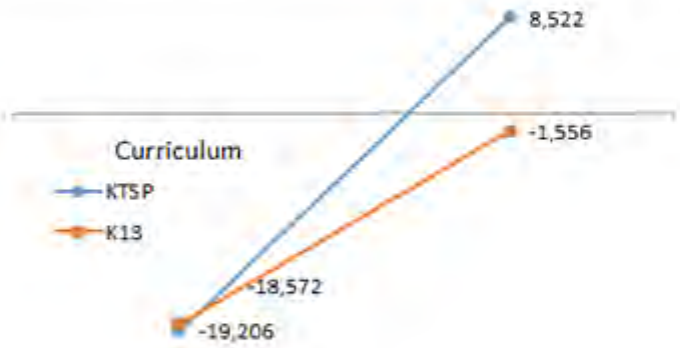

Figure 3. *Contribution of Curriculum on the Effect of NTS on IMTS*

Discussions, Conclusion, and Recommendation

Table 3 and 4 showed consistent findings related to the effect of the National Test Score on International Mathematics Test Score. It is related to the findings of Yilmaz & Hanci (Kaleli-Yılmaz & Hanci, 2015). A higher score of national indicated a better international score of mathematics skills. The reasons are national tests have an equal function with the international one to qualify the mathematical abilities of students, objectives of competencies of national and international test are related (Carnoy et al., 2016; Stacey, 2011), the type of national test of mathematics is widely imitated to mathematics national test (Retnawati, 2017), and the trend of national and international test scores are equal.

The findings indicated that different types of mathematical problems (PISA/TIMSS) are likely to have different impacts of national examinations on international math tests. PISA and TIMSS results showed that the rank on PISA was equal to the ratings on TIMSS. Thus, this confirms the fundamental difference between PISA and TIMSS in measuring mathematical ability (Wu, 2010). The different concepts of PISA and TIMSS provide various benefits to each country. PISA type seems to have a better effect on the national score to the international mathematical score rather than TIMMS. Indonesian students are expected to have better scores on PISA as a contextual test rather than TIMMS. It is related to the decline of the TIMSS scores for Indonesian students since 1999/2000. In the beginning, TIMSS score at 2003/2006 was 411, 2006/2007 was 397, 2011/2012 was 386, and 2015 was 397 (Mullis et al., 2011; OECD, 2013, 2015). However, the scores of PISA are likely to increase. This result seems opposite to the findings of Wu (Wu, 2010). He found that most of the students in Asia and East European countries performed better at TIMMS type than the PISA, yet the western countries concerned for the PISA type.

Different types of the curriculum were also found to have different effects of national to the international score of mathematics test. This finding supported

Scheerens findings (Scheerens, 2019). Hence, it is plausible that the development of the curriculum aimed to increase the result of the learning processes. The KTSP type of curriculum was found to have a better effect of national on the international score of mathematics test. It seems to contradict with the concept of the curriculum development objectives. It is expected that application of KTSP had deeper concerns on knowledge rather than 2013 version of the curriculum which was stressing on attitude and skill (Ilma & Pratama, 2015; Retnawati et al., 2016). It is related to the previous findings indicating that teachers have reached no optimal level of 2013 curriculum implementations (Amat Jaedun, V. Lilik Hariyanto, Nuryadin, 2014; Trisnawati, Gunawan, & Nongkeng, 2016). Hence, the implementation of the 2013 version should be evaluated.

It is concluded that both different curriculum and test types of mathematics have a significant effect on the influence of national to the international mathematics test score. The higher effect of national to international mathematics test scores depended on the context of the curriculum and test type used. Hence school leaders must pay more attention to the implementation of curriculum and choice of the type of test. However, the sample of this study was limited to a specific region in Indonesia. The conclusion of this study shows the effect of national test scores on international test scores is higher when the type of international test is PISA rather than TIMSS, and school which applies KTSP curriculum on their learning process have a better effect of national test scores of mathematics on international test scores rather than 2013 Curriculum.

The result of this study recommends the following studies to investigate broader sampling which represents the model in Indonesia. The implementation of the 2013 curriculum is still in development. Hence, the application of the 2013 curriculum in the ideal stage is needed to represent the concept of the 2013 curriculum. Different objectives of PISA and TIMSS are challenging. Accordingly, future research is suggested to employ a bigger sample implementing the 2013 curriculum and to analyze the details of PISA and TIMSS domain.

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